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ABSTRACT

This literature study was conducted to compare and evaluate various types and techniques of weight lifting so that a weight lifting program could be selected or devised for a secondary school. Annotations of 32 research reports, journal articles, and monographs on isotonic strength training are presented. The literature in the first part of the study justifies the importance of weight training based upon its popularity and benefits. A review and identification of various strength training methods is presented in the second section. Materials in the third section deal with the physiological effect of weight training, addressing the body's reaction to weight training, the aerobic and anaerobic stages in maximal muscular contractions, and the derived strength and aerobic benefits from weight lifting. In the fourth section, studies evaluating various weight lifting techniques are reviewed, comparing repetitions, sets, and number of workouts per week. The fifth section provides research on motivational techniques along with measurement suggestions. A summary of the findings and conclusions based on comparisons of cost and effectiveness lead to four recommendations on equipment and methodology for high school weight training. A glossary of weight training terms is provided. (Author/JD)

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AN ANNOTATED BIBLIOGRAPHY OF ISOTONIC WEIGHT-TRAINING METHODS

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INTRODUCTION

Weight lifting has been particularly popularized recently and was considered to be one of the biggest booms in the fitness field. Women and men have realized that weight lifting has helped in the development of attractive physiques. People have also found that upper body development had greater significance to their present occupations than the development of the body through a running program (Lang: 58).

Weight-lifting programs were considered to be superior in muscle building when compared to other forms of physical activity (Kirkley: 9). Physical educators must have the knowledge to establish proper weight-training programs to meet this increased demand in body building. Coaches of various sports will also be required to research training techniques and equipment to maximize the motor performance abilities of their athletes.

The benefits of strength programs should be evaluated by all physical educators. An attractive physique can be developed in a relatively short period of time. Also, strength was found to be: basic to good performance in skills, a measure of physical fitness, and helpful to have attained an increased physically healthy body (Mathews: 53-54).

Fleck identified five types of strength training: isometric, isotonic, variable resistance, isokinetic, and eccentric (Fleck: 84-88). Knowledge of isotonic weight-lifting techniques was the most desired because eccentric and isometric training can be easily implemented in a weight-training program

through the use of isotonic equipment (see conclusions p.24). Also, variable resistance training equipment closely parallels isotonic equipment. Isokinetic equipment is quite high priced (see appendix p.33) when contrasted to isotonic equipment. Knowledge of isotonic techniques in weight lifting was considered desirable because a physical educator or coach can purchase or devise isotonic equipment at a very low cost. "Excellent makeshift dumbbells or barbells can be made from pipes inserted in cans of different sizes filled with cement. If the coach and athletes use a little imagination, initiative in devising equipment, and the necessary safety precautions, the isotonic exercise program can be successful" (Gallon: 108).

STATEMENT OF THE PROBLEM AND PURPOSE OF THE STUDY

The values of weight lifting have been established (Fleck, Coleman, Whitley and Smith, Berger and Hardage, Withers, et. al.). One must research various techniques of weight lifting to fully have optimal utilization of existing equipment.

This study was conducted to compare and evaluate various types, as well as techniques, of weight lifting so that a weight-lifting program could be selected or devised. This paper dealt specifically with isotonic strength training because this type was the most practical and available to the author.

ORGANIZATION OF THE STUDY

The researched material was broken down into five categories. There were overlapping areas in some of the research, but the main ideas were categorized into the area which seemed most appropriate.

The first part of the study justified the importance of weight training based upon the popularity and benefits as outlined in the proceeding material.

The second section was a review and identification of various strength-training methods.

The third section dealt with the physiological effect of weight training. This section specifically addressed itself to the body's reaction to weight training, the aerobic and anaerobic stages in maximal muscular contractions, and the derived strength and aerobic benefit from weight lifting.

Section four reviewed various weight-lifting techniques. This section compared repetitions, sets, and number of workouts per week. Proper form when lifting weights was formulated along with contrasted volume levels and intensity levels to be used when weight training.

The fifth section provided research on motivational techniques along with measurement suggestions. This section emphasized the means to have weight-lifting goals obtained as well as a means to have the progress of the weight lifter measured.

LIMITATIONS OF THE STUDY

This study was limited primarily to strength and power measurements. Weight-training methods evaluated on their ability to increase a specific sport's motor performance would have been more highly desired than the simple measurement of strength to perform a weight-lifting motor performance.

Time spent on research was also limited by a time factor placed on its completion. The very nature of weight training provided an almost

unlimited scope when the number of repetitions, sets, and types of weight-training equipment were attempted to be compared and evaluated. The very design of this field of study leaves an educator with great difficulty in the selection or improvision of one best weight-training program. If one wishes to have a weight program established, the aspects of the program should be periodically re-assessed and re-evaluated.

DEFINITION OF TERMS

Adenosine triphosphate--"the basic compound which provides energy for the body," (Bartels: 30).

Aerobic--"the process by which food is broken down to provide energy when oxygen is used in this process," (Bartels: 30).

Anaerobic--"the process by which food is broken down to provide energy when oxygen is not used in this process," (Bartels: 30).

Bicep--"the large flexor muscle of the front of the upper arm," (Webster: 82).

Calf--"the fleshy hinder part of the leg below the knee," (Webster: 118).

Cardiovascular--"of, relating to, or involving the heart and blood vessels," (Webster:126).

Circuit training--"a system of conditioning that involves an athlete's moving, within a limited time schedule, among six or ten places, or 'stations,' and performing a specific exercise at each station," (Gallon: 123).

Deltoid--"a large triangular muscle that covers the shoulder joint and serves to raise the arm laterally," (Webster: 219).

Dynamometer--"an instrument for measuring mechanical force," (Webster: 259).

Eccentric training--"a muscular contraction in which the muscle lengthen while contracting. Lowering a weight is an example of an eccentric contraction," (Fleck: 86).

Fast twitch muscle fibers--"There are two fast twitch muscle types which respond quickly to stimulation and produce relatively greater force when activated by the nervous system. These fast twitch fibers (FT) are subdivided into those which are used more frequently and have moderately good endurance (FT_a) and those that are used principally during maximal muscular contractions and have poor endurance (FT_b)," (Costell, Sharp, and Troup: 29).

General Adaption Syndrome (GAS)--"a theory which proposes three phases of adaption by the body to demands made on it, such as by exercise. The first phase relates to the initial response to a stimulus. The second phase of adaption corresponds to the preparation period in training when an athlete's body is developing in such a way as to increase training and/or performance potential. The third phase of GAS corresponds to overtraining (lack of desired adaptation). A reasonable periodization of training should avoid the constant 'pushing' of one's body which leads to chronic fatique (overtraining)," (Stone, O'Bryant, and Garhammer: 342).

Gravity Inversion Boots--"boots which have hooks on them that let people hang upside down from bars," (Lang: 61).

Hypertrophy--"a state when muscle fiber size has increased. This will develop greater strength," (deVries: 367).

Isokinetic--"means constant speed. In this type of strength training the speed of movement for the exercise is set, not the amount of weight to be lifted. The isokinetic device will not move any faster than the speed at which it is set, if maximal voluntary contractions are performed against the isokinetic device," (Fleck: 83).

Isometric--"An isometric contraction is a muscular contraction in which the muscle maintains a constant length. Isometric contractions are usually performed against an immovable object, such as a wall or a weight too heavy to be lifted," (Fleck: 84).

Isotonics--"of, relating to, or exhibiting equal tension," (Webster: 451).

Lacti acid-system--"In this system, a sugar molecule, glucose, which contains six carbon atoms, is converted to pyruvic acid, which has three carbon molecules. In this process, two ATP molecules are created and two pairs of hydrogen ions (H^+) are produced. These hydrogen ions must be removed from the system. If the level of work is 'easy' and adequate oxygen is present, the hydrogen ions can combine with oxygen to make water as follows: $2H^+ + 1/2O_2 \longrightarrow H_2O$. If the work is very strenuous, then there is not enough time for the hydrogen ions to combine with oxygen to make water and the hydrogen ions are removed by combining with pyruvic acid to form lactic acid," (Bartels: 30).

Latissimus dorsi--"a large muscle which covers the posterior outer surface of the lower four ribs. This muscle extends, adducts, rotates the arm medially; draws shoulder downward and backward," (Jacob and Francone: 194).

Motor--"of, relating to, or involving muscular movement," (Webster: 553).

Nueromuscular--"of or relating to nerves and muscles or nervous and muscular tissue," (Webster: 568).

Overload principle--"subjecting a muscle to greater loads than those to which it is accustomed," (deVries: 367).

Pectoralis major--"muscle which covers the chest area; this muscle flexes, adducts, rotates arm medially," (Jacob and Francone: 194).

Power--"calculated as the force which can be applied in a given joint movement time the velocity of the movement, /Power = Force x Velocity/," (Huesner: 16).

Quadriceps--"the great extensor muscle of the front of the thigh divided above into four parts," (Webster: 698).

Repetition maximum (RM)--"the maximum weight that can be lifted for the indicated number of repetitions," (deVries: 373).

Schwinn Air-Dyne Ergometric Exerciser--"a modern technological apparratus used to condition the upper body. It has levers extending from the floor that are used to exercise arms and shoulders. The faster the levers are moved, the more exertion is needed," (Lang: 60).

Slow twitch muscle fiber--"Those fibers that respond slowly to stimulation produce the least maximal tension, but have good aerobic endurance, are classified as slow twitch fibers," (Costill, Sharp, and Troup: 29).

Strength--"the maximum force that can be exerted one time, and it's measured in pounds," (Huesner: 16).

Triceps--"the great extensor muscle along the back of the upper arm," (Webster: 945).

VO_2 Maximum--"the maximal volume of gas that can be expired from the lungs by forceful effort following a maximal inspiration," (deVries: 150--as reprinted from Comroe, Julius H., et. al., The Lung, Yearbook Medical Publishers, Inc., Chicago, 1962, 2nd ed.)

Variable resistance--"a type of strength training where a machine attempts to vary the amount of weight being lifted to match the strength curve of a particular exercise. The machine attempts to make the weight heavier and lighter as the amount of weight the individual can lift changes through the range of motion of a particular movement. This is usually accomplished through a lever arm or cam-type arrangement," (Fleck: 85).

Ventilatory--"of, relating to, or provided with ventilation," (Webster: 986).

ANNOTATIONS

JUSTIFICATION OF WEIGHT TRAINING

Lang, John S., "America's Fitness Binge," U.S. News and World Report 92:58-61, May 3, 1982.

Lang claimed the biggest current boom in the fitness field has been weight training--for women as well as men. Most converts to body building are women who have begun to realize that pumping iron will not necessarily give them bulging muscles.

The body building trend has followed new findings that Americans have not exercised their upper bodies enough. Lang brought out the idea that the popular activity of jogging has not strengthened the ability for most people to cope with their present occupations. He further stated that most people use their arms throughout their workday but remain seated. He also pointed out that while jogging may help lessen the risk of heart trouble, it will also cause the development of foot and knee problems.

Lang noted the great amount of new technology in the weight-lifting field. These inventions included the Schwinn Air-Dyne Ergometric Exerciser and Gravity Inversion Boots.

Mathews, Donald K., Measurement In Physical Education, W. B. Saunders Co., Philadelphia, 1964, 2nd ed., pp. 53-60.

Mathews stated there were four good reasons why strength should be evaluated. He claimed that these reasons were important to the physical educator, to the physical education program, and to the students.

Strength and appearance was cited as an important reason and Mathews emphasized that students must be made to believe that an attractive physique can be obtained in a relatively short time. Mathews stated that strength was basic to good performance in skills, that strength served as a measure of physical fitness, and that maintenance of strength may serve as a prophylaxis against certain orthopedic deficiencies.

Mathews also provided a history of strength training as used with isometric training. This written material included the use of various measuring instruments to be used when isometric strength is measured.

Kirkley, George, Weight Lifting and Weight Training, Bell Publishing Co., New York, 1963, pp. 9-11, 124-132.

Kirkley stated that a weight lifting program was a superior muscle building program when contrasted to other forms of physical activity. He also claimed that weight lifting needed to be progressive either in poundage or repetitions if one's potential was to be realized.

A time program of an hour to an hour and a half was proposed along with the concept of at least three, but no more than four, workouts per week. Two week lay-offs were also advocated to regain mental intensity.

Kirkley insisted that the intensity of training will be governed largely by the individual's interest and ambition. The individual's ambition must be pursued by a relentless determination if optimal gains are to be realized.

COMPARISON AND IDENTIFICATION OF VARIOUS WEIGHT-TRAINING METHODS

Fleck, Steve, "Types of Strength Training: Pros and Cons," Swimming Technique 16:84-88, Fall, 1979.

Fleck has examined five types of strength training: isometric, isotonic, variable resistance, isokinetic, and eccentric training. All five techniques were explained and contrasted to one another. Fleck pointed to many studies to state that isokinetic training: (1) increased strength, (2) increased isotonic and isokinetic strength, (3) increased motor performance, and (4) led to less muscular soreness more than any of the other four forms of strength training.

The only disadvantage Fleck attached to isokinetic training was the cost of equipment that was necessary. He concluded that strength gains were obtained by all the strength training methods when voluntary maximal contractions were included in the training regimen. However, he analyzed that isokinetic or fast isokinetic training was the preferred type of program.

Coleman, Alfred E., "Comparison of Weekly Strength Changes Following Isometric and Isotonic Training," The Research Quarterly 12:26-29, March, 1972.

Twenty-three male college students trained their upper limbs by isometric and isotonic techniques for a period of eleven weeks. The strength for five repetition maximums was recorded of the forearm flexor muscles during each week of training. Comparisons were made to determine which technique produced more rapid strength gains.

The results of this test showed that there were no significant differences between the two training methods. On the basis of this experiment, it was concluded that gains in muscular strength will occur at a similar rate when training through the use of an isometric program or an isotonic program.

Gettman, Larry R.; Culter, Lynne A.; and Strathman, Timothy A., "Physiological Changes After 20 Weeks of Isotonic Vs. Isokinetic Circuit Training," Journal of Sports Medicine and Physical Fitness 20:265-274, September, 1980.

This study compared the effects of isotonic and slow-speed isokinetic circuit strength training conducted at 12 repetitions per exercise through a 20-week conditioning program. Significant and similar improvements were seen in aerobic work capacity for both types of training methods. The authors observed a 7 and 8 percent increase in VO_2 maximum and a decrease in body percent fat (-1.9% and -2.8%) for isotonic and isokinetic training, respectively.

The authors stressed that the aerobic work capacity improvements induced in the study were moderate when compared to the 12 to 20 percent improvements observed in running and walking programs tested by Gettman, Pollock, Ayres, and Grantham.

Beka, David E., "Comparison of Dynamic, Static and Combination Training of Dominant Wrist Flexor Muscles," The Research Quarterly 39:244-250, March, 1968.

Beka tested four groups of five subjects each. He established a static, dynamic, combination, and control group which were tested in maximum strength increases in dynamic strength, and at three static angled tests at three different positions.

Beka found that there were no statistically significant differences among dynamic, static, and combination training methods in developing maximum static strength of the dominant wrist flexor muscles. The combination group improved significantly over the static group in dynamic strength gains and increased slightly over the strictly dynamic group. The static, dynamic, and combination groups were all superior to the control group in both dynamic and the various static tests.

Hopper, Bob, "Getting a Grip on Strength," Swimming Technique 17:10-13, August, 1980.

Hopper stated that muscle strength was limited by two factors: a neuromuscular factor which included the rate of messages from the central nervous system to the brain, the number of fibers recruited and/or the type of fiber (fast twitch or slow twitch), and a muscle factor which included the size of fiber and the number of fibers.

Hopper then identified and contrasted four different types of weight lifting: isometric, eccentric, isotonic, and isokinetic He emphasized the movement-specificity factor of an isokinetic program and that the muscle is maximal over the full range of motion.

The author concluded that isokinetic exercise was most effective in the neuromuscular area of strength due to the movement velocity specificity and that isotonic exercises were very effective in the development of muscle size. He concluded that there was room for both types of training because no one system was best.

Whitley, Jim D. and Smith, Leon E., "Influence of Three Different Training Programs on Strength and Speed of a Limb Movement," The Research Quarterly 37:132-142, March, 1966.

Whitley and Smith conducted tests which measured static strength and speed of movement of the arm in a horizontal position. These tests were given to four experimental groups which numbered 26 in each group. One group trained with the use of isometric-isotonic principles, one with dynamic-overload principles, one with a free swing movement without any resistance, and one group was a control group which was not involved in any physical activity that might affect arm speed and/or strength in the test range of movement.

Test results showed significant increases in both strength and speed for the groups which trained with resistant force and no significant increase in the groups which did not train with resistive forces. The authors concluded from this study and studies by Henry and Chui that the increased strength of muscles involved in a movement makes it possible for individuals to execute a faster movement. They claimed that this held true for any strength exercise program which builds specific muscle strength.

PHYSIOLOGICAL EFFECTS OF WEIGHT TRAINING

Stone, Michael H.; Garhammer, J.; O'Bryant, H., "A Hypothetical Model for Strength Training," The Journal of Sports Medicine and Physical Fitness 21:342-350, December, 1981.

The authors tested 31 high school football players, which were picked at random, to test their proposed weight-training method (periodization) to the traditional method of 3 x 6 RM. The subjects were tested over a 12-week period. The periodization technique was found to be superior in strength testing to the more traditional model.

The concept of periodization has been based on the principles of the General Adaption Syndrome. This program allows for the body to gradually adapt to the resistance training demands placed upon it. The model consisted of four phases: (1) Hypertrophy, high volume-low intensity, (2) Basic Strength, moderate volume-high intensity, (3) Strength-Power, low volume-very high intensity, and (4) Active Rest, very low volume-very low intensity.

The authors recommended concentration on training method improvements to bring about superior results as opposed to the use of modern day gimmicks and devices. They advocated the use of free weight exercises.

Cooper, Kenneth H., Aerobics, M. Evans and Co., Inc., New York, 1968, pp. 1-26.

Cooper greatly advocated the value of aerobic conditioning. He claimed that weight lifting has such little benefit to aerobic conditioning that weight lifting was excluded from his list of beneficial exercise programs. He stated that isotonic exercises have very little demand on the oxygen-consumption process and that these exercises only train the skeletal muscles. He concluded that this type of exercise program was much too narrow in scope to even be seriously considered as a primary conditioner.

He stated that the whole key to a proper conditioning program was to increase the body's ability to deliver oxygen to its working parts. Cooper's analysis of weight training was best stated on page 13: "Muscular fitness is of some value, but it is too limited. It concentrates on only one system in the body, one of the least important ones, and has limited beneficial effect on the essential organs or overall health. It's like putting a lovely new coat of paint on an automobile that really needs an engine overhaul."

McArdle, William D. and Foglia, Guido F., "Energy Cost and Cardiorespiratory Stress of Isometric and Weight Training Exercises," The Research Quarterly 9:23-30, March, 1969.

The purpose of this study was to determine the metabolic, ventilatory, and cardiovascular response to the common methods of isometric and isotonic weight training, (maximum six second contraction and eight repetition maximum, respectively).

The authors concluded that the results of this study indicated that isometric and, to a lesser degree, isotonic strength training exercises provided a minimal method for the improvement of the heart's exercise tolerance. This study revealed that the tested weight-training programs were insufficient if a program's goal was to increase one's cardiovascular condition. It should be noted that the time to have completed an isotonic exercise was ranged from 24 seconds to 36 seconds.

Bartels, Robert L., "Aerobic or Anaerobic: The Terms and Their Training Implications Explained," Swimming World 22:30-33, September, 1981.

Bartels identified three energy systems of the body. These systems were the non-lactic acid system, the lactic acid system, and the oxygen debt system. He claimed that the first two systems were anaerobic and that the lactic acid system is exhausted of its immediate supply of energy in about 45 seconds of "all-out" work. He also claimed that the build-up of lactic acid within the tissues is what causes the pain of exhaustion.

Bartels stated that the lactic acid system had a greater capacity to provide adenosine triphosphate (ATP) than the non-lactic acid system but that it could not provide it as rapidly, and that it is, therefore, less powerful. He identified the oxygen debt system as an aerobic system because it involved the use of oxygen. Bartels stated that aerobic fitness could be measured by the amount of oxygen an individual can take in per minute. The author claimed that during the oxygen debt system it was the oxygen which provided the ATP and that ATP was the basic compound which provided energy for the body.

Skinner, James S. and McLellan, Thomas H., "The Transition From Aerobic to Anaerobic Metabolism," The Research Quarterly 51:236-246, March, 1980.

Skinner and McLellan identified three phases of metabolism when an exercise program ranged from low intensity to maximal intensity. These phases included an aerobic phase, a transitional phase, and then finally an anaerobic phase. Data from this study indicated that if weight-lifting programs have included as their goals the concept of building muscular endurance and aerobic conditioning, then the length of time spent when working at a weight station should be long enough to go beyond the aerobic metabolic phase.

When the aerobic metabolic phase was completed, the authors stated that the muscle fiber would be worked to a greater extent. Skinner and McLellan's tests and measurements were applied to leg exercises on a bicycle ergometer, treadmill walking, and arm-cranking exercises. The authors advocated research in various exercise programs in order to determine this aerobic to anerobic transitional phase.

WEIGHT-TRAINING TECHNIQUES

Gallon, Arthur J., Coaching Ideas and Ideals, Houghton Mifflin Co., Boston, 1980, 2nd ed., pp. 95-115, 123.

Gallon differentiated between weight lifting as a sport and what he called "resistance training." The sport of weight lifting has as its goal to lift a given maximum poundage. Resistance training is a series of exercises that progress sequentially and increase total fitness and strength. He recommended that an isotonic exercise program should be conducted at least three days a week. Monday may involve maximum lifts with few repetitions; Wednesday may be spent lifting to approximately 50 percent of maximum ability, increasing the number of repetitions in order to develop endurance; the resistance lifting on Friday should be 75 percent of maximum.

Gallon recommended three sets of 10 and to work the large muscle groups first and then the smaller groups. This routine allowed for less fatique while muscles still worked to their full extent through the planned workout.

Gallon also advocated the use of an isokinetic program for maximum muscle development when compared to isometric and isotonic programs. The higher cost of isokinetic weight equipment was mentioned as a possible liability.

Darden, Ellington, "Athletes Get 'Back' in the Game Utilizing Progressive Workouts," Swimming World 21:24-26, February, 1980.

Darden stated that the only practical and systematic way to be progressive in a strength program was to increase the resistance of force in the weight-training workout. He stressed that below a certain level of intensity, no amount of exercise would produce increases in strength.

The author provided a guideline for weight training and emphasized that the following rules be applied to all resistant training methods: "(1) Use as many full-range movements as possible to insure development of the entire length of the involved muscle, and to increase flexibility. (2) Stress correct form; avoid fast, jerky movements. (3) Raise the weight to the count of two--lower the weight slowly and smoothly while counting to four and repeat. (4) Perform only one set of eight to 12 repetitions in each exercise. Begin with a weight that can be comfortably performed eight times. Stay with that weight until 12 strict repetitions can be performed, then raise the weight five percent and go back to eight repetitions. (5) Include a maximum of 12 different exercises in an entire workout. (6) Train no more than three times a week."

deVries, Herbert A., Physiology of Exercise, William C. Brown Publishing Co., Dubuque, Iowa, 1974, 2nd ed., pp. 365-384.

deVries advocated the application of the overload principle for optimal strength gain. He claimed that when the desired strength is realized, it can be retained by one maximal contraction per week.

He also stressed that for maximal accuracy, strength testing should be applied under conditions which would stay constant. This included the time of day, temperature, and psychological state of mind.

deVries emphasized the importance of the schedule when a program is organized. He stated that workouts should be scheduled no less than three and no more than four times weekly for optimal results. The total exercise program should be scheduled so that no more than one workout per week approaches exhaustion.

Gregory, Larry W., "Some Observations on Strength Training and Assessment," The Journal of Sports Medicine and Physical Fitness, 21:130-136, June, 1981.

Gregory contrasted the differences between training frequencies of two times per week versus three times per week. This study consisted of 152 male adults and their strength improvements were compared at the beginning, middle, and end of 14 weeks of training. The criterion for strength was one repetition maximum for the bench press, sitting press, leg press and biceps curl.

It was concluded that both frequencies produced a significant gain in strength but that the three times a week training schedule resulted in a higher adjusted means, and a greater absolute and percentage gain. The three times per week training schedule group produced greater results but the differences were not notably significant. The three times per week training schedule group gained only 5.2 pounds in absolute strength and 2.7 percent gain in original strength when contrasted to the two times per week training schedule group.

Massey, Benjamin H. and Chaudet, Norman L., "Effects of Systematic, Heavy Resistive Exercise on Range of Joint Movement in Young Male Adults," Research Quarterly 27:41-51, March, 1956.

This article studied the effects of systematic, heavy resistive exercises on the range of joint movement of male adults. The study involved two groups of 13 each. The experimental group trained with weights for six and a half months while the control group participated in other kinds of physical activity. Range of joint movement was tested prior, midway, and at the end of the training period.

In summary, the weight-training program did not appear to affect range of movement. There was not a significant increase or decrease in the range of movement for the joints throughout the body.

Massey and Chauket referred to studies by Hairabedian, Masely, and Doualdson which provided evidence that weight training does not restrict bodily movement in terms of speed of muscular contraction. These studies supplemented their own study which proved that weight training will not result in a loss of flexibility.

Berger, R. A. and Hardage, B., "Effects of Maximum Loads for Each of Ten Repetitions on Strength Improvement," Research Quarterly 38:715-718, March, 1967.

This study examined whether weight training with maximum or near maximum loads for each of 10 repetitions was more effective to gain increased strength than the performance of 10 repetitions with the 10-RM load. Group I (N=24) performed 10 repetitions with the 10-RM for one set. Group II (N=26) performed 10 repetitions for one set, but each repetition required a maximum or near maximum load capacity.

After the training period, the analysis showed that Group II had a significantly higher mean result. The greater muscular force which was repeatedly performed by subjects in Group II resulted in the significantly greater increase in strength when compared to the strength test results of Group I.

Based upon this study, it was concluded that a weight-training program which employed the use of maximum or near maximum load for each of the 10 repetitions would result in greater strength gains than a program of 10 repetitions with the 10-RM method. This theory can only be applied to the lifter with no previous lifting experience and who trained three times weekly for eight weeks.

Withers, T., "Effect of Varied Weight-Training Loads on the Strength of University Freshmen," The Research Quarterly 41:110-114, March, 1970.

The following three weight-training programs were compared and contrasted on the basis of aquisition of muscular strength. three sets of seven repetitions maximum (3 x 7 RM), four sets of five repetitions maximum (4 x 5 RM), and five sets of three repetitions maximum (5 x 3 RM). The schedule of the weight-training program was 30-minute workouts, two times per week, and for the duration of nine weeks. The groups were identified as A, B, and C, respectively.

When groups were compared and contrasted, the statistical analysis favored B over A, B over C, and C over A when results were based on the greatest mean single maximum that each group produced.

Withers concluded that a progressive weight-training schedule results in a statistically significant increase in strength. He also stated that beginners increased in strength more rapidly when training on 4 x 5 RM than with either 3 x 7 RM or 5 x 3 RM.

Gable, Dan and Peterson, James A., Conditioning For Wrestling: The Iowa Way, Leisure Press, West Point, New York, 1980. pp. 26-45.

Gable and Peterson detailed seven basic variables to be considered for the establishment of a muscular fitness development program. These variable included exercises to be performed, the order, the number of repetitions, the amount of weight to be used, the number of sets, the amount of rest to be taken between exercises, and the number of workouts per week.

In the authors' detailed account which addressed the question of how many repetitions to be performed, they elaborated on the one set 8-12 repetitions (1 x 8-12 RM) which were advocated by Nautilus Sports/Medalist Industries.

The authors stressed the vital importance of top conditioning programs to the success achieved in athletics. The material contained ideas and illustrations for the development of a conditioning program and the organization for a muscular fitness program.

O'Shea, Patrick, "Effects of Selected Weight Training Programs on the Development of Strength and Muscle Hypertrophy," The Research Quarterly 37:95-102, March, 1966.

This experiment was conducted to determine the effects of a weight-training program on the development of muscle hypertrophy and strength. The deep knee-bend exercise was used with varying repetitions. Three groups of ten in number were made up. Group A did three sets of 9-10 repetitions, Group B did three sets of 5-6 repetitions, and Group C did three sets of 2-3 repetitions. The criterion for the effectiveness of the program was the measurement of: (a) thigh girth, (b) dynamic strength as measured by one RM on the deep-knee bend, and (c) static strength as measured on the dynamometer.

All the training programs resulted in the improvement of static and dynamic strength, but there were no significant differences between the three programs. O'Shea concluded that it made little difference whether a person trained on three sets of 2-3, 5-6, or 9-10 repetitions.

Stull, G. Alan and Clarke, David H., "High-resistance, Low-repetition Training as a Determiner of Strength and Fatigability," The Research Quarterly 41:189-193, March, 1970.

Stull and Clarke used a six-week training program of high-intensity, low-repetition exercise and measured the initial strength, final strength, total work done, and fatigable work. They used their results to contrast this type of weight program to a low-intensity, high repetition exercise program conducted previously by Stull. The authors stated that the low-intensity, high repetition exercise programs were considered to be best for gains in endurance while the high-intensity, low-repetition programs were considered best when the development of hypertrophy or muscular strength was the program's objective.

In the authors' comparison, no significant differences were found in any of the above tested categories. Stull and Clarke maintained that when the primary objective was maximal work that both programs were highly successful. The authors advocated the high-intensity, low-repetition weight programs over the low-intensity, high-repetition weight programs because the overload technique involved a much less time factor when executed.

MOTIVATION AND MEASUREMENT OF WEIGHT TRAINING

McKethan, J. F. and Mayhew, J. L., "Effects of Isometrics, Isotonics, and Combined Isometrics-Isotonics on Quadriceps Strength and Vertical Jump," Journal of Sports Medicine and Physical Fitness 14:224-227, September, 1974.

Nine-week training programs involving isotonics, isometrics, and a combination of the two were evaluated on the basis of quadricep strength and the resulting vertical jump performance. Isotonics significantly increased quadricep strength.

The authors pointed to studies by Darcus and Salter which stated that lack of visible stimulus (improvement) resulted in boredom and a conscious or unconscious reduction in effort when isometric training was involved.

The authors emphasized that strength training patterns should be closely associated with performance patterns to be of significant benefit. This opinion was based upon research by Henry, Whitely, Laycoe, and Martenink.

Topolski, Thomas, "Strength Training Tips for Coach and Swimmer," Swimming Technique 16:100-102, Winter, 1980.

Topolski stressed the importance of proper recordkeeping in order to have athletes motivated. He also stated that if accurate data would be kept, then instructors could have their weight programs evaluated more efficiently.

The concept of proper warm-up was also stressed. Topolski footnoted Astrand and Rodahl who stated that warm-up would increase body temperatures and would lubricate joints. Topolski stated that warm-up was important if optimum results and injury-free training was to occur.

The author also stated that a coach should make use of sound training methods and sound contemporary training practices. He claimed that coaches should be aware of the basic principles which govern exercise and keep current on those principles. A thorough individual training record chart was also included in the article.

Johnson, Barry L. and Nelson, Jack K., Practical Measurements for Evaluation in Physical Education, Burgess Publishing Co., Minneapolis, 1974, 2nd ed., pp. 88-101, 113-122.

This material contained isotonic strength tests for: pull-ups, dips, bench squat, sit-ups, bench press, and standing vertical arm press. Well-organized tests for muscular endurance were also included. The endurance tests included bent-knee sit-ups, flexed-arm hang, chin-ups, half-squat jump, push-ups, dips, and squat thrusts.

All tests were outlined and were organized to cover ten specific areas. These sections included the objective, recommended age level, recommended sex, reliability factor, objectivity, validity, necessary equipment and materials, directions, scoring, and additional pointers for each individual test.

Johnson, Barry L. and Nelson, Jack K., "Effect of Different Motivational Techniques During Training and In Testing Upon Strength Performance," The Research Quarterly 38:630-636, December, 1967.

The authors applied a variety of motivational techniques to isometric weight-training students throughout the duration of their training and testing. Subjects were divided into four groups. Group I received no feedback on their results; Group II received the knowledge or feedback of their results; Group III received the knolwedge of their results plus an assigned goal; and Group IV received knowledge of their results plus an assigned goal plus a placebo effect by which experimenters provided a pill to the group and the group was told that the pill would give them additional aquired strength. Based upon their results, the authors concluded that strength measures were greatly increased when motivational techniques were included in both training and testing. Also, the best scores for the motivated group occurred in the latter stages of training while the non-motivated group did not perform well in the latter stages of training.

SUMMARY

Weight training was found to be a justified study. Lang pointed to its popularization and Americans' trend for a desired increase in upper body development. This public demand of weight-training devices has skyrocketed sales for equipment and increased technological inventions in the body-building field. Mathews emphasized the benefits of a strength program and claimed benefit to the physical educator, the physical education department, and to the students when these benefits were realized.

Types of weight training seemed to clearly overlap and the identification of the different types varied. Four types of weight training were distinctly identified by Hopper--isometric, isotonic, isokinetic, and eccentric. The isokinetic training was preferred by Fleck although he stressed the high cost of isokinetic equipment. Hopper and Gettman et. al. claimed there was no one best training method and that isotonic and isokinetic were both beneficial. Coleman concluded that there was no significant differences between isometric and isotonic weight-training results. Whitley and Smith concluded that any strength-training program also increased an individual's speed of movement.

The body was shown to have definite reactions to weight training. The periodization of weight training was emphasized by Stone, O'Bryant, and Garhammer. They claimed the body needs to adapt to high-intensity weight training. Bartels explained the anaerobic to aerobic transition in muscular training. It was generally agreed that weight-lifting was not a good aerobic or cardiovascular exercise (Cooper, McArdle and Foglia).

Weight-training techniques were emphasized. Gregory concluded that workouts of three times per week were somewhat more beneficial than workouts

of twice weekly. Darden stressed a full range of motion, correct form and timing when a lift was performed, advocated one set of eight to twelve repetition maximums, and advised to train no more than three times a week. Gable and Peterson provided guidelines for the establishment of a weight-training program. deVries, Berger and Hardage emphasized high-intensity overload workouts to best develop muscle hypertrophy and strength, while O'Shea, Stull and Clarke concluded that it made little difference whether high-volume or low-volume weight lifting was performed. Both advocated low-volume because of a greater time efficiency.

One best technique did not clearly stand out, but Gable and Peterson concluded that maximal effort in performance resulted in acquired strength and power.

McKethan and Mayhew pointed to studies by Darcus and Salter which stated that weight lifters must have positive feedback to perform up to individual maximum capacity. Johnson and Nelson (1967) agreed with this and also provided various testing methods to have isotonic strength evaluated (1974).

CONCLUSIONS

All strength training methods reported significant gains in strength, but the cost of various equipment must be considered when a weight-training program is selected. Isokinetic equipment to train the entire body ranged in price from $2,345-25,000 (see appendix p.33) for a Nautilus machine. Research concluded that isotonic weight equipment is more practical and readily available than all other strength training forms with the exception of isometric training. Even isometric training has costs as devices must be purchased to measure strength levels. Many high schools have isotonic weight-lifting machinery (see appendix p.34) and these Universal machines ranged in price from $2,000 to $6,745 (see appendix p.33). Without any weight equipment, one can still easily build or devise isotonic dumbbells or barbells to workout with. Knowledge of isotonic weight-lifting technique would be advisable because the necessary equipment to perform other types of strength training (isokinetic in particular) was found to not always be available.

To have selected one best weight-training program, endless permutations and combinations of sets and repetitions would have to be compared. Also, a successful weight program can only be deemed such if the objectives of training are reached. These objectives could be strength, power, endurance, or any combination of the three to the muscles which one desires to have developed.

The increased power levels of motor performance included both strength and endurance. Therefore, the development of power was concluded to be most significant in a well-rounded weight-training program. To increase power, work must be performed at progressively higher intensities (Berger

and Hardage, deVries, Darden), and the volume of work should correspond to the anaerobic failure of the muscle (Medalist--see appendix p. 32). Bartels claimed that the lactic acid system was exhausted of its immediate supply of energy in about 45 seconds of all-out work. Medalist Industries' representative claimed that anaerobic muscle failure occurred between 40-72 seconds during maximal muscle contractions. A timed lift seemed most suited to meet the above criterion. A two seconds concentric force with a four second eccentric contraction would allow for six seconds on each lift (Darden). This slow lift procedure would allow for a nonexplosive lift and would, therefore, not create damage to the muscular joints. If one followed the one set 8-12 repetition maximum program (1 x 8-12 RM) proposed by Medalist and Darden, lifts of maximal muscle contractions would range from 48 seconds (6 seconds x 8 repetitions) to 72 seconds (6 seconds x 12 repetitions) and would have failed the anaerobic ability of the muscle to produce ATP. A person should not power or strength train beyond the lactic acid system because the aerobic system has much less comparative power (Bartels). When this aerobic system was utilized, less strength would be available and consequently the intensity (so necessary for strength and power development) would be lessened. It was stated by Medalist that it was also important to all-out work up to the aerobic stage so as to completely work the muscle to its total exhaustion.

The importance of warm-up exercises for optimum results and injury-free training was stressed by Topolski. Workouts of three times a week were deemed as most beneficial by Darden, Kirkley, and deVries.

Also, a period of adaptation (Stone, Garhammer, O'Bryant) should also be allowed when a weight-training program would be implemented. The weight

program should have included a low-intensity high-volume adjustment period so the body would be better prepared to meet the demands to be placed upon it.

If the two second concentric force and four second eccentric contractions are adhered to, then negative weight lifting is being performed and the eccentric and isotonic training described by Fleck would be integrated. To go one step further on the 8-12 RM program by the implementation of the concept of always trying to lift the next weight until the muscle fatigues, the concept of isometric training has now also been incorporated. Weight should be increased by five percent once 12 RM has been performed. The new weight should have the 8 RM applied to it (Darden).

The sequence of lifts should have included the larger muscles worked first and then the smaller muscles. The larger muscles to be included would be the latissimus dorsi, pectoralis major, deltoid, triceps, biceps, quadriceps, and calf muscles (Gallon). The 8-12 RM program would be applied to the specific muscles to be developed for each sport or the muscle to be developed in a body-building course. This system could then have met criteria for specificity of training described by McKethan and Mayhew. If aerobic conditioning is a desired result, then the weight-training programmer should allow for less rest between work stations. Although great aerobic benefit is inefficient when compared to other forms of exercise (Cooper), aerobic benefits can still be gained through weight-lifting programs (Gettman, Culter, and Strathman).

Many different methods of weight training showed significant gains. Therefore, possibly the best concept to be applied to strength or power development was stated by Kirkley as he emphasized that a weight-lifter must pursue an increased intensity or volume with a state of undeniable

determination. Also, weight lifters should be given positive feedback on their results through accurate records being kept and new assigned goals given as present goals are met (Johnson and Nelson 1967).

Lastly, the planned weight-training program must consistently be re-assessed and re-evaluated as experimentation continues to have better concepts and techniques revealed. The application of better techniques will result in an improved program. The preceding proposed program was based upon research and should provide significant gains in power. It was certainly not deemed to be undisputable. Revision or change must be applied for its improvement when further research indicates to do so.

RECOMMENDATIONS

It is recommended that:

1. Serious consideration be given to the evaluation of the 1 x 8-12 RM program's merit in both strength, power, and endurance development when performed properly (Bartels, Darden, and Medalist Industries).

   A. The 8 x 12 RM program is based upon complete muscle exhaustion by working through Bartel's non-lactic acid and lactic acid stages.

   B. Medalist explained the limit to the aerobic to anaerobic phase to be 72 seconds.

   C. Darden emphasized the form necessary to have timed lifts on each repetition.

   D. Constant effort to increase either volume or intensity must be executed for gains in muscular strength, power, and endurance.

2. Proper adaptation periods be provided before maximal training (Stone and Garhammer).

   A. Stone and Garhammer's weight-training program was devised with consideration given to the general adaption syndrome as it effects the body.

3. Workouts be three times per week (Darden, Kirkley, deVries, and Gregory).

   A. For muscle hypertrophy development, high-intensity workouts are required. The muscle must have sufficient rest between workouts in order to be properly prepared for performing high-intensity workouts.

4. Weight lifters be given positive feedback on performance and on assigned goals (Topolski, Johnson and Nelson).

   A. Accurate feedback provides on increased motivation to work.

   B. Setting goals incorporates a direction for a weight-lifting program.

   C. Positive feedback on performance has increased one's ability to achieve a goal along with an increased reward for goal achievement.

BIBLIOGRAPHY

Bartels, Robert L., "Aerobic or Anaerobic: The Terms and Their Training Implications Explained," Swimming World 22:30-33, Setpember, 1981. (14)

Bartels, Robert; Coyle, Edward; Huesner, William; and McLaughlin, Thomas, "Scientists Talk About Strength Training," Swimming Technique 17:16, August, 1980.

Beka, David E., "Comparison of Dynamic, Static and Combination Training of Dominant Wrist Flexor Muscles," The Research Quarterly 39:244-250, March, 1968. (11)

Berger, R. A. and Hardage, B., "Effects of Maximum Loads for Each of Ten Repetitions on Strength Improvement," The Research Quarterly 38:715-718, March, 1967. (17)

Coleman, Alfred E., "Comparison of Weekly Strength Changes Following Isometric and Isotonic Training," The Research Quarterly 12:26-29, March, 1972. (10)

Cooper, Kenneth H., Aerobics, M. Evans and Co., Inc., New York, 1968, pp. 1-26. (13)

Costill, Dave; Sharp, Rick; and Troup, John, "Muscle Strength: Contributions to Sprint Swimming," Swimming World 21:29, February, 1980.

Darden, Ellington, "Athletes Get 'Back' in the Game Utilizing Progressive Workouts," Swimming World 21:24-26, February, 1980. (15)

deVries, Herbert A., Physiology of Exercise, William C. Brown Publishing Co., Dubuque, Iowa, 1974, 2nd ed., pp. 365-384. (16)

Fleck, Steve, "Types of Strength Training: Pros and Cons," Swimming Technique 16:84-88, Fall, 1979. (10)

Gable, Dan and Peterson, James A., Conditioning For Wrestling: The Iowa Way, Leisure Press, West Point, New York, 1980, pp. 26-45. (18)

Gallon, Arthur J., Coaching Ideas and Ideals, Houghton Mifflin Co., Boston, 1980, 2nd ed., pp. 95-115, 123. (15)

Gettman, Larry R.; Culter, Lynne A.; and Strathman, Timothy A., "Physiological Changes After 20 Weeks of Isotonic Vs. Isokinetic Circuit Training," Journal of Sports Medicine and Physical Fitness 20:265-274, September, 1980. (11)

Gregory, Larry W., "Some Observations on Strength Training and Assessment," The Journal of Sports Medicine and Physical Fitness 21:130-136, June, 1981. (16)

Hopper, Bob, "Getting a Grip on Strength," Swimming Technique 17:1--13, August, 1980. (11)

Jacob, Stanley W. and Francone, Clarice Ashworth, Structure and Function in Man, W. B. Saunders Co., Philadelphia, 1974, 3rd ed., p. 194.

Johnson, Barry L. and Nelson, Jack K., "Effect of Different Motivational Techniques During Training and in Testing Upon Strength Performance," The Research Quarterly 38:630-636, December, 1967. (21)

Johnson, Barry L. and Nelson, Jack K., Practical Measurements for Evaluation in Physical Education, Burgess Publishing Co., Minneapolis, 1974, 2nd ed., pp. 88-101, 113-122. (20)

Kirkley, George, Weight Lifting and Weight Training, Bell Publishing Co., New York, 1963, pp. 9-11, 124-132. (10)

Lang, John S., "America's Fitness Binge," U.S. News and World Report 92:58-61, May 3, 1982. (9)

Massey, Benjamin H. and Chaudet, Norman L., "Effects of Systematic, Heavy Resistive Exercise on Range of Joint Movement in Young Male Adults," The Research Quarterly 27:41-51, March, 1956. (17)

Mathews, Donald K., Measurement In Physical Education, W. B. Saunders Co., Philadelphia, 1964, 2nd ed., pp. 53-60. (9)

McArdle, William L. and Foglia, Guido F., "Energy Cost and Cardiorespiratory Stress of Isometric and Weight Training Exercises," The Research Quarterly 9:23-30, March, 1969. (13)

McKethan, J. F. and Mayhew, J. L., "Effects of Isometrics, Isotonics, and Combined Isometrics-Isotonics on Quadriceps Strength and Vertical Jump," Journal of Sports Medicine and Physical Fitness 14:224-227, September, 1974. (20)

O'Shea, Patrick, "Effects of Selected Weight Training Programs on the Development of Strength and Muscle Hypertrophy," The Research Quarterly 37:95-102, March, 1966. (19)

Skinner, James S. and McLellan, Thomas H., "The Transition From Aerobic to Anaerobic Metabolism," The Research Quarterly 51:236-246, March, 1980. (14)

Stone, Michael H.; Garhammer, J.; O'Bryant, H., "A Hypothetical Model for Strength Training," The Journal of Sports Medicine and Physical Fitness 21:342-350, December, 1981. (12)

Stull, G. Alan and Clarke, David H., "High-resistance, Low-repetition Training as a Determiner of Strength and Fatigability," The Research Quarterly 41:189-193, March, 1970. (19)

Topolski, Thomas, "Strength Training Tips for Coach and Swimmer," Swimming Technique 16:100-102, Winter, 1980. (20)

Webster's Seventh New Collegiate Dictionary, G. and C. Merriam Co., Springfield, Massachusetts, 1970, 1217 pp.

Whitley, Jim D. and Smith, Leon E., "Influence of Three Different Training Programs on Strength and Speed of a Limb Movement," The Research Quarterly 37:1[illegible], March, 1966. (12)

Withers, T., "Effect of Varied Weight-Training Loads on the Strength of University Freshmen," The Research Quarterly 41:110-114, March, 1970. (18)

Appendix A

Medalist Sports Representative, Medalist Sports Education, Medalist Basketball Clinic, Fort Wayne, Indiana, May, 1981, 800-558-6848.

The lecturer emphasized that in order to build strength, muscle maximum failure must occur. He advocated that a high intensity-low repetition would be most effective for strength development. He stated that the goal of a strength weight program would be to have the muscle anaerobically fail and that this occurred in a 40 to 72 second range when maximal muscle contractions had taken place. He advocated the importance of progressive intensity in order to have increased strength.

Although a strong emphasis was placed on weight intensity, the concept of correct form and technique was also brought out. He stated that weight should be lifted with two seconds up and four seconds down and that this eccentric contraction was very important. He emphasized to not be explosive in technique and that this would damage the muscular joints. The speaker advocated these six second lifts be applied to a one set 8-12 RM program with as little recovery time between weight training stations as possible in order to greater enhance cardiovascular and aerobic conditioning factors. Workout periods of every other day were stressed along with the importance of a brief program of 30 minutes to have more assurred intensity for the duration of the workout.

Appendix B

COMPARISON OF NAUTILUS AND UNIVERSAL WEIGHT MACHINES*

	Nautilus	Universal
Price range	$2,345 - 25,000	$2,000 - 6,745
Minimum no. stations in workable program	2	10
No. individuals on full circuit in 60 min.	10	40
Space requirement (sq. ft.)	100	70
Portable	No	No

*Source: Swimming Technique 17:36-37, August, 1980.

Appendix C

*Public Schools in Elkhart and Koskiosko County having Isotonic Weight Machines:

Elkhart Memorial

Elkhart Central

Wawasee

Northwood

Goshen

Concord

Warsaw

Fairfield

Jimtown

Whitko

*These high schools were selected because of the area familiarity to the author. This appendix shows the availability of isotonic equipment as every public school in the two-county area had purchased isotonic weight-training equipment.

BACKGROUND

Name: John Vincent Wysong

Education: Tri-State University, B.S., 1976
Major: Business Education
Minor: Physical Education and Economics

Experience: Wawasee High School, 1981-present
Syracuse, IN
Physical Education instructor, Grades 9-12
Varsity Boys' Basketball Coach

Fairfield Jr./Sr. High School, 1978-1981
Goshen, IN
Social Studies instructor, Grades 7 and 8
Health instructor, Grade 10

Angola High School, 1976-1978
Angola, IN
Business instructor, Grades 9-12
Junior Varsity Boys' Basketball Coach
Cross Country Varsity Coach

Rationale:

The study of isotonic weight lifting was selected largely because the possibility has existed that an instructor will be needed for the class "Weight Lifting and Body Building" presently offered at Wawasee High School. Researched information on isotonic weight lifting was also needed to develop a power weight-lifting program to be implemented within the Wawasee basketball program. This study has better prepared the author to instruct a weight-lifting class and to implement a sound, researched weight program. As a physical educator, a condensed course in weight lifting was taught this past year and greater knowledge was required to more effectively instruct in this area. This study's purpose was to provide much needed additional knowledge to better meet academic and extra-curricular obligations of the author to Wawasee High School.